Biotechnology

Alberta
TECHNOLOGY, RESEARCH
AND TELECOMMUNICATIONS

A Message from the Minister

Alberta's achievements in biotechnology have gained respect for our scientists and markets for our products worldwide. And we are just in the early stages of developing the Province's potential in one of the world's most exciting and commercially promising areas of scientific investigation.

Alberta's solid research environment sets the stage for the nurturing of a vigorous biotechnology sector. Through the Alberta Heritage Foundation for Medical Research, Alberta attracts and supports renowned scientists from all parts of the world, and encourages young and innovative researchers.

Alberta has developed excellent universities and unique facilities such as the Biotechnology Pilot Plant at the Alberta Research Council.

This first-class scientific infrastructure, combined with Alberta's entrepreneurial flair and excellent mechanisms for the smooth transfer of technology from laboratory to marketplace, ensures the province is a vital contributor to world biotechnology.

Fred A. Stewart
Minister
Technology, Research
and Telecommunications

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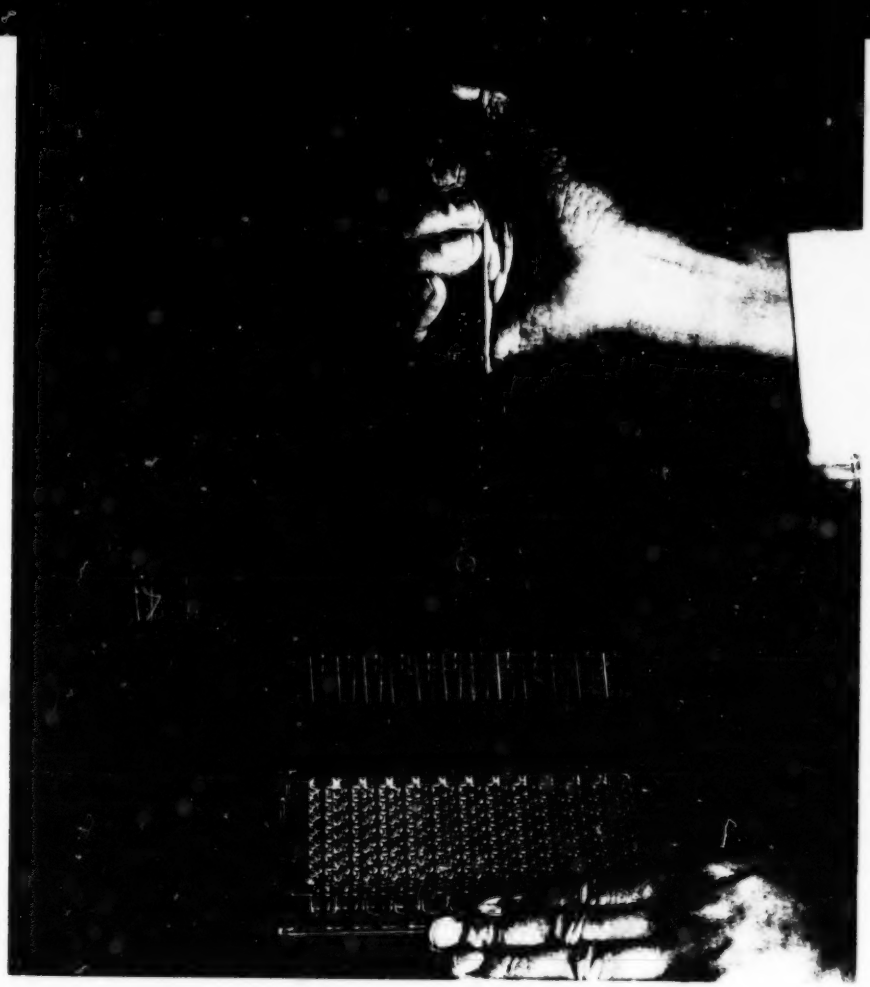
Biotechnology

...the second industrial revolution

It has been called the science of the future...the technology of all living matter. Biotechnology is harnessing nature to meet man's needs. It includes any technique which uses living organisms to make or modify products, to improve plants or animals, or to develop micro-organisms for specific uses.

It encompasses a wide range of scientific disciplines and includes among its tools and techniques:

- recombination DNA,
- cell fusion (hybridoma) technology,
- clonal propagation,
- embryo manipulation,
- gene transfer,
- protein engineering,
- advanced bioprocessing,
- increasingly efficient fermenters, and,
- the most sophisticated computer simulation and modelling techniques available to science.



Nuclear Magnetic Resonance machine used in research and evaluation.

Despite the explosion of publicity surrounding what is being called "the last great technological revolution of the 20th century", more traditional forms of biotechnology have been around for centuries. Selective livestock breeding goes back to Biblical times. Fermenting grapes to make wine is an ancient technology. And traditional herbal remedies were based on the healing powers of substances found in nature.

In the health care and agricultural industries, over the last 10 years, there has been an accumulation and use of biotechnological techniques which have been enhanced by the ability to use recombinant DNA technology.

Today's approach to biotechnology lies in science's ability — since the genetic code was broken less than two decades ago — to literally reach inside living matter to directly engineer the genetic material of individual cells.

Considering the economic implications, today's surge of global interest in biotechnology is understandable. World sales of biotechnology products are projected to reach $180 billion by 1994 — increased from $50 billion a mere decade earlier. Many analysts predict that biotechnology will rival, or even surpass, the electronics industry in its economic and social impact on the world.

Alberta Enterprise

...at the leading edge

■ Since the late 1970s, universities, research agencies, industry, governments and private investors worldwide have cooperated to foster the development of biotechnology. The Province of Alberta is committed to the advancement of this sector and has identified it as a key target area for economic opportunities.

■ The Government's goal is to encourage economic diversification in a young and aggressive province, by creating a climate for nurturing scientific research and technology-intensive business.

■ With science and technology identified as areas of high priority, the provincial government spends more on research and development (per capita) than that of any other government in Canada.

■ The result of this thrust can be seen in Alberta's research-oriented universities and highly regarded technical training institutes. It is visible in new and superbly equipped biotechnology research facilities and medical science complexes. And it is apparent in a growing community of biotechnology companies, many based on partnerships involving government, university and the private sector.

■ Alberta's determination to impact world biotechnology has resulted in a fast growing industry that has significant annual sales and provides quality jobs for well over 600 Albertans.

Canada's Landmark Bill C22

■ Alberta has been a leading supporter of Bill C22 with respect to compulsory licensing. The Bill, which has been passed into legislation deals with patent protection for pharmaceutical manufacturers. It is expected to have major long-term implications in Alberta, where biotechnology and pharmaceuticals have been identified as cornerstones of economic diversification.

■ The Bill, which gives pharmaceutical manufacturers 10 years to market new products without fear of competition, is expected to spawn a new wave of joint research and development activities. Alberta's recognized expertise in pharmaceuticals and exceptionally attractive research climate mean the province is well suited to benefit from the increased protection for the research and development of these companies.

In 1985-86 to 1986-87 funding to Alberta Universities for biotechnology research and development, totaled almost $20 million.

$19,612,400

Provincial Government
$5,517,600

Private
$3,059,000

Alberta Universities

...birthplace of a vigorous industry

Alberta's universities have a long tradition of research excellence and are considered world leaders in many areas of biotechnology research.

University of Alberta

The University of Alberta in Edmonton houses more than 75 scientists dedicated to research in various aspects of biotechnology. And the University's reputation for research expertise is enhanced by the presence of a biochemistry department which is one of the most comprehensive and progressive in Canada.

The work of the Protein Structure Group has long commanded international attention and respect. The University's Centre of Protein Engineering and Drug Design along with researchers in the fields of immunology and molecular genetics enhance that reputation.

Many of Alberta's commercial ventures in pharmaceuticals and health care can trace their beginnings to research conducted in University of Alberta laboratories.

(Above right) A bioluminescent image of genetically engineered plants, and (right) extracting DNA from cells during *in vitro* screening for anti-hepadnavirus agents (hepatitis B) – University of Alberta.

Inoculating rats in the development of diagnostic kits for cystic fibrosis – University of Calgary.

University of Calgary

More than 50 researchers from the faculties of Medicine, Engineering and Science are directly involved in biotechnology research at the University of Calgary.

The University's Fermentation Facility and Genetic Engineering Laboratory form the backdrop to a multidisciplinary research program that focuses on medical diagnostics and therapeutics, plant and animal biotechnology, process engineering, and environmental technology.

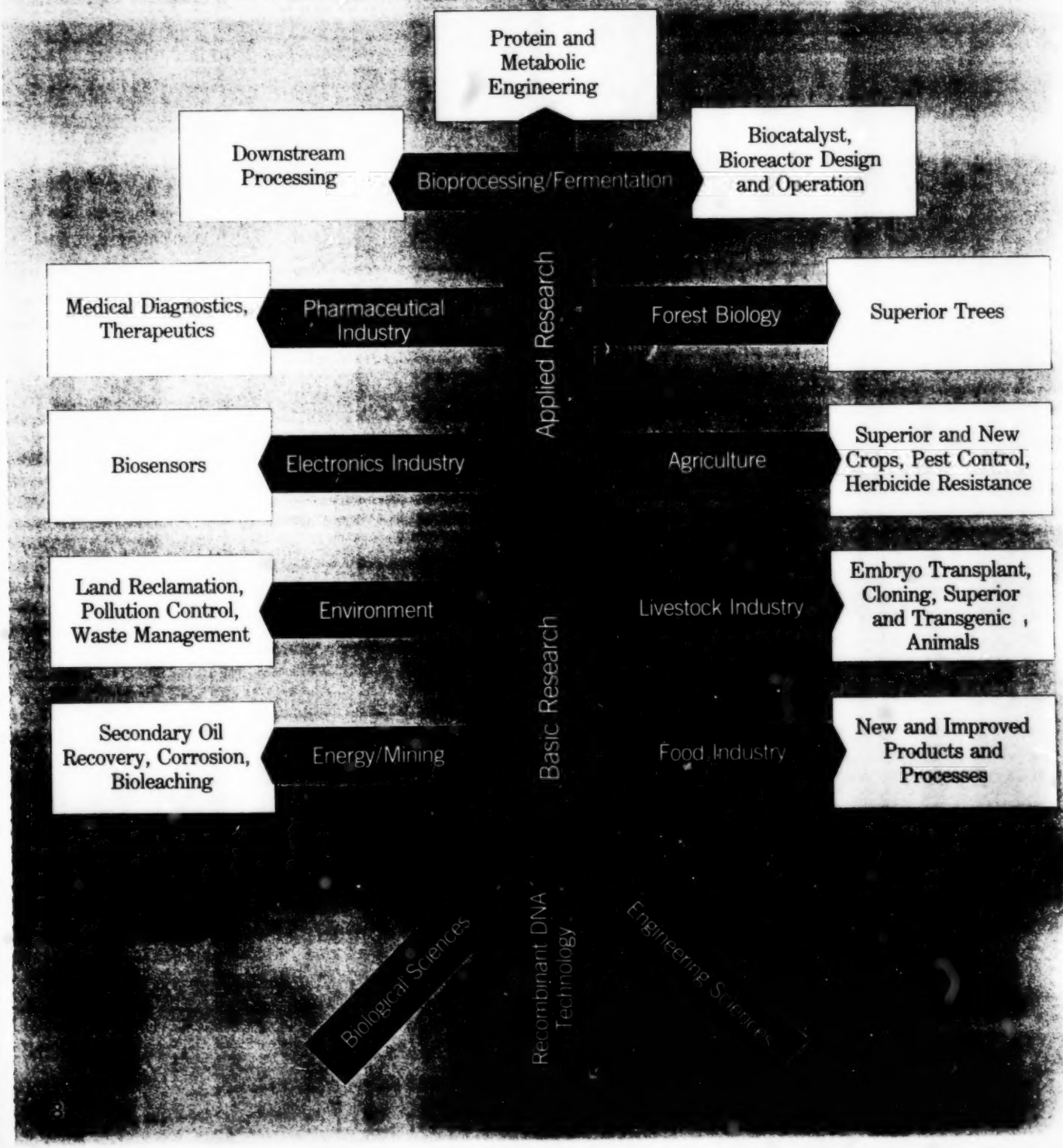
Recognized as having one of the largest and most respected groups of molecular biologists in Canada, the University of Calgary has also gained international acknowledgement for its pioneering work in embryo manipulation and gene transfer in domestic livestock. The University's research expertise has spun off a number of successful biotechnology ventures.

Technology Transfer

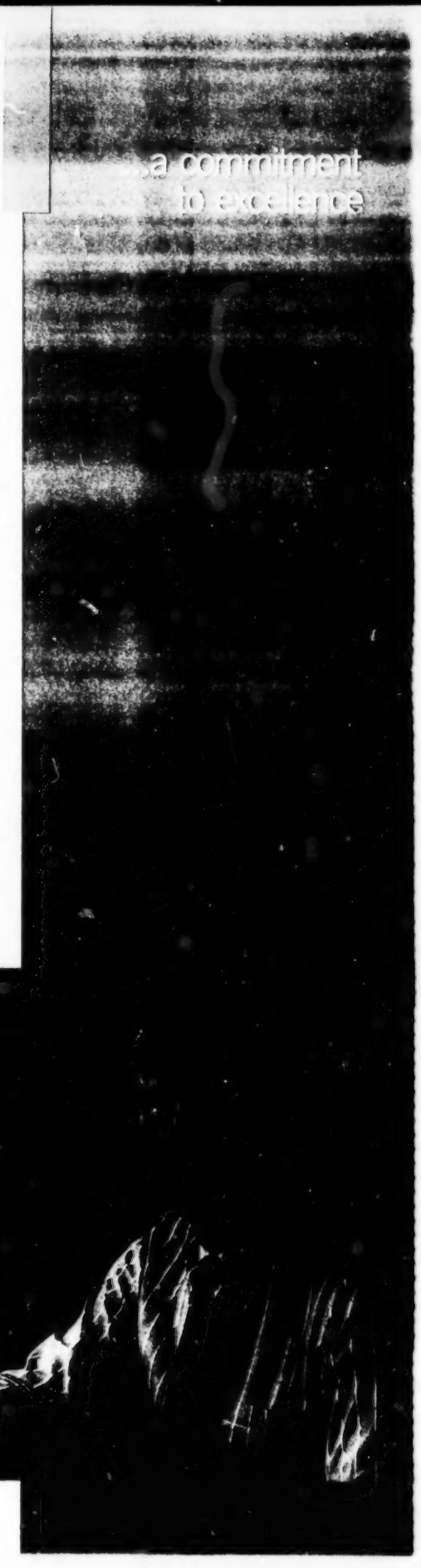
Working to bring together researchers and private and public sector investors, technology transfer offices in Alberta's universities facilitate technology patenting and licensing, joint ventures, and other contractual arrangements.

In all research activities, the universities stress close cooperation with the private sector and encourage commercialization of new products and technologies.

Biotechnology in Alberta



Focus on Education, Training



In Alberta, people, policies, and pleasing lifestyle combine to attract and favor the growth of technologically-advanced enterprises.

Honing Albertans' academic and technical skills has made the Province home to an impressive core of engineers, scientists and biotechnologists. In fact, the Province has the highest per capita concentration of scientists, engineers and technology specialists in Canada.

Today, Alberta supports a new generation of professionals, technicians and support staff with skills directly geared to biotechnology and biomedical research, development, manufacturing, and marketing.

The Province's commitment to education — for undergraduate and graduate students as well as for established scholars — is substantial. It is evident through such vehicles as the Alberta Heritage Foundation for Medical Research (AHFMR). The AHFMR supports advanced scientific study, enhancing the province's most critical basic resource — its people. Over 140 senior scientists have been recruited from Alberta, Canada, and around the world to support the development of Alberta's innovative medical research environment.

The Alberta Heritage Scholarship Fund too, encourages the pursuit of excellence by recognizing outstanding achievement. In excess of $58 million has been awarded to over 41,000 Albertans since 1980.

X-ray Crystallography
– University of Alberta.

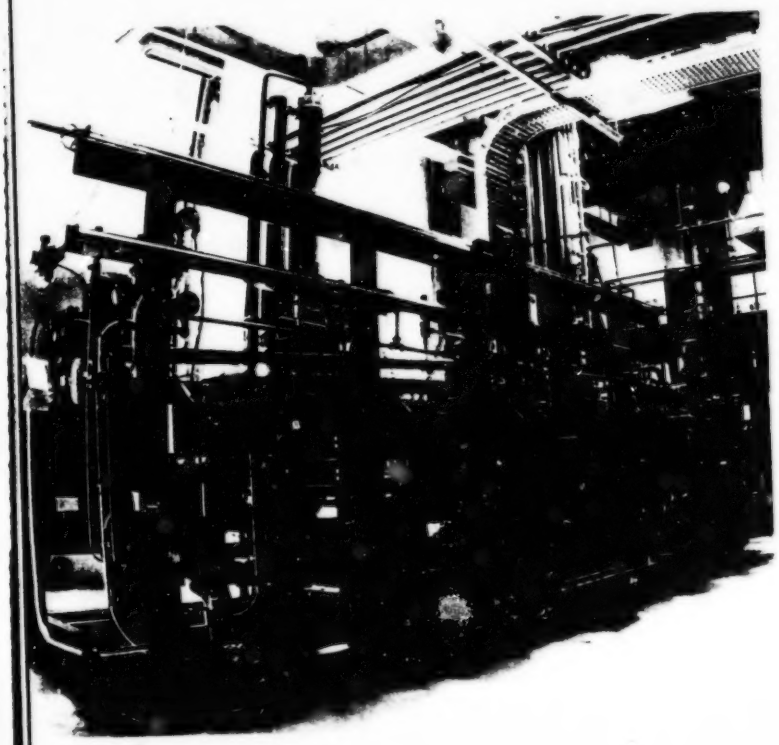
Facilities, Funding and Programs

A Place for Business

Alberta offers appeal as a business location. Services to industry include research and development parks with abundant, economically-priced commercial land in major centres; high-tech incubator facilities designed to help and encourage start-up operations; venture capital pools supportive of advanced technology enterprise; and a comprehensive range of government counselling and assistance programs for business and industry.

To complete the picture, Alberta has one of the lowest personal and corporate tax structures in Canada, a tradition of political and labor stability, and a highly-trained and productive workforce.

Alberta's lifestyle has many advantages. Few places in the world can match the quality of life and prosperity enjoyed by Albertans. A vast and beautiful natural environment, a world-class recreational system, a rich, diverse culture, and modern health care and social services, make Alberta a superb place to live.

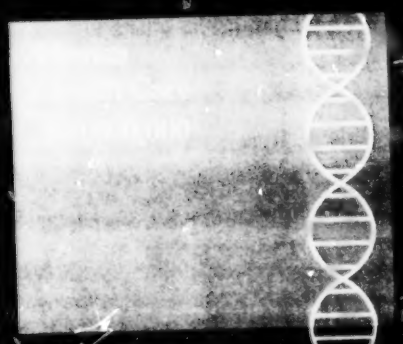


Norac Technologies Inc. uses Supercritical Gas Extraction to separate substances from agricultural products.

...impressive support network for biotechnology

In 1985-86 to 1987-88, the Alberta Government invested over $70 million in biotechnology activity in the province.

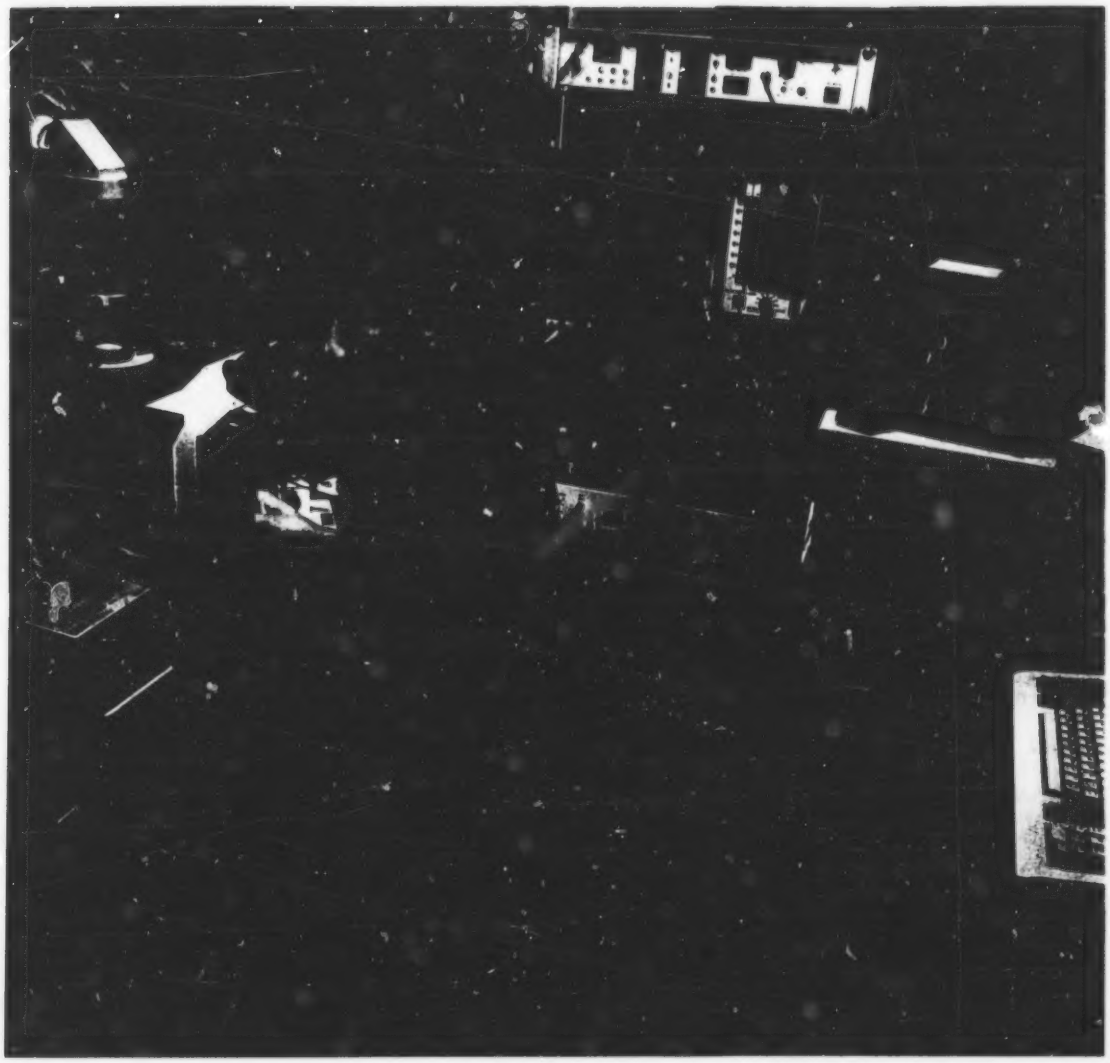
$70,590,320



Agriculture (animal and plant) $23,308,320

Bioprocessing $16,630,000

Other $52,000



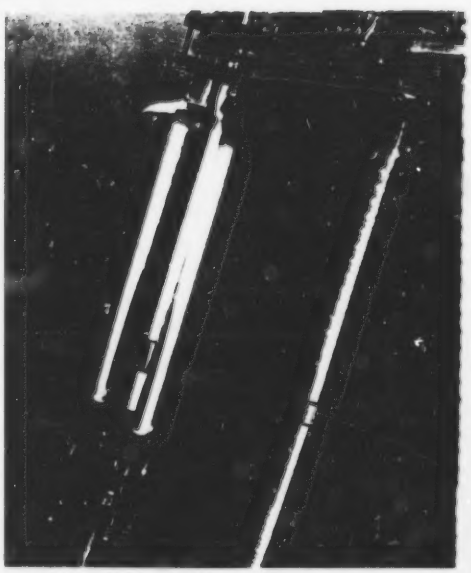
Investigating herbal sources of active compounds – University of Alberta

A Place for Research

Facilities and programs in Alberta are designed to encourage and support scientific and business activity in the field of biotechnology.

The **Alberta Heritage Foundation for Medical Research (AHFMR)** was established by the Alberta government in 1979 to encourage medical research in Alberta. Originally supported by a $300 million endowment fund, AHFMR devotes millions of dollars annually from investment earnings to an exceptional awards and grants program that has established a critical mass of career scientists in Alberta.

In order to accommodate the work of the multidisciplinary medical research groups in Alberta, the Foundation has invested in two major new laboratory complexes – the **Heritage Medical Research Buildings** in Edmonton and Calgary. In addition, AHFMR funds an aggressive technology transfer program which is beginning to see the work of Alberta's fast growing medical research community translated into successful commercial ventures.



(left) A 15,000 litre fermentation vessel being installed at the Alberta Research Council's Biotechnology Pilot Plant.

(below) Micro-organisms growing in a bench-scale fermentor – Alberta Research Council.

Also playing an important role in biomedical research are institutions such as the University of Alberta Hospital's flagship **Walter C. Mackenzie Health Sciences Centre**, the **Cross Cancer Institute** in Edmonton, which provides clinical drug trial assistance, and **Calgary's Centre for the Advancement of Health**. Combining the expertise of the **Tom Baker Cancer Centre**, the **Alberta Foothills Hospital**, and the **University of Calgary Faculty of Medicine**, and in collaboration with the **Alberta Children's Hospital**, the **Centre for the Advancement of Health** facilitates contract research with commercial enterprise. Unique in Canada, the Centre makes available assistance in clinical investigation, drug trials, and basic research.

The **Alberta Oil Sands Technology and Research Authority** promotes research and development of technology in the oil industry. One of its major projects concerns field experiments using bacteria to enhance downhole oil recovery.

The **Alberta Research Council's Biotechnology Pilot Plant and Toll Facility** reflects the priority interest and expertise in biotechnology developed at the Research Council's Edmonton headquarters over the past decade. One of the largest, most modern and flexible plants of its kind in the world, it is available to industry on a fee-for-service basis, offering technical expertise and fermentation facilities with a nominal capacity of 25,000 litres, expanding to 40,000 litres by 1990.

Working in partnership with companies at the provincial, national and international levels, ARC biotechnologists help industry with process development, scale-up, and limited manufacturing. BIOSYS Inc., a California-based biotechnology firm and biopesticide developer is one of many international clients drawn to Alberta by the ARC's scale-up capabilities. BIOSYS Alberta Ltd. expects to establish a $20 million manufacturing operation in the province, fully operational by 1992.

Front and centre in agricultural research is the **Alberta Agricultural Research Institute** which offers programs to support the research and development of new products and technologies of potential benefit to Alberta's agri-food industry.

The **Farming for the Future** program spends roughly $5 million annually to support research activities, including biotechnology projects, designed to improve the viability of the agricultural sector.

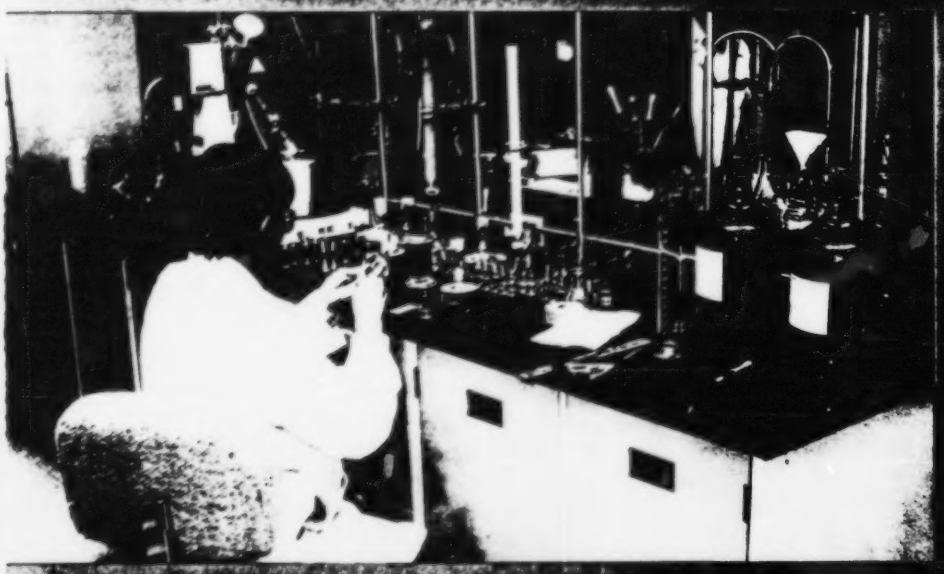
Other Alberta-based agencies with an interest in the agricultural, environmental, and industrial aspects of biotechnology include the **Food Processing Development Centre** at Leduc, the toxicology units at the **Alberta Environmental Centre** at Vegreville, and agricultural research stations and veterinary laboratories throughout the province.

Alberta has been one of the major supporters of the **Western College of Veterinary Medicine** and its spin-off **Veterinary Infectious Diseases Organization (VIDO)**, one of the leading Western Canadian groups in veterinary disease. As cooperative ventures of the four western provinces, both organizations help to commercialize research expertise.

Scale-up production of entomogenous nematodes to commercial level - BIOSYS Inc.

Leading Scientists

On the international stage, Alberta [illegible] stature of its scientists. And they have earned [illegible] entific discoveries but also for their ability [illegible] laboratory to the business arena. Alberta scientists are making [illegible] contributions in such areas as diagnostics, pharmaceuticals, [illegible] graphy, monoclonal antibodies, and animal and [illegible] some of Alberta's leading researchers.



Dr. Larry Bryan

Dr. Bob Church and Dr. Stein Willadsen

Dr. Bill Costerton

At the University of Calgary, Dr. [illegible] is working on enhanced oil [illegible] using microorganisms. His research has resulted in major commercial involvement in medical devices and pollution control. Dr. Costerton is recognized [illegible] for his biotechnology application of biofilm used in medical and environmental pollution concerns as well as [illegible]. His scientific reviews have been declared "citation classics", a worldwide distinction previously accorded to less than 30 Canadian publications in all areas of science.

Dr. [illegible]

An expert in the areas of fungal metabolism and antibiotic production, Dr. [illegible] leads a University of Calgary research team of innovative biochemists and microbiologists. A major effort is directed towards the isolation and characterization of the enzymes and genes used in the biosynthesis of a model polyketide antibiotic and mycotoxin.

Dr. David Hoar

[illegible] Director of Alberta Children's Hospital Molecular Diagnosis Laboratory, [illegible] established Canada's first [illegible] diagnosis capability for human [illegible]. His work is directed towards the development of probes for diagnosis and detection of carriers of a number of disorders associated with genetic [illegible]. Diagnosis lab also provides [illegible] testing and forensic [illegible].

Dr. Robert Hodges

[illegible] of Biochemistry at the [illegible] Alberta, Dr. Hodges has [illegible] leader in peptides — [illegible] occurring substances that [illegible] bodily processes. Through Synthetic Peptides Incorporated, Dr. Hodges [illegible] colleagues are developing peptides [illegible] engineering to produce pharmaceuticals, diagnostics and synthetic vaccines and to develop software programs [illegible] documentation for an international [illegible] biology community.

At the University of Alberta, Dr. James uses his expertise in x-ray crystallography to unravel the mysteries of protein structure to better understand biochemical reactions within the body, and use that knowledge in rational drug design. Research conducted for a California biotechnology company on recombinant human kidney renin, an enzyme in the body which affects blood pressure, is expected to lead to the design of a new drug for blood pressure control.

Dr. Lemieux, Professor Emeritus of Chemistry at the University of Alberta, was the first chemist to synthesize common table sugar. He propelled Alberta into world biotechnology markets with his groundbreaking discoveries in biologically active carbohydrates. Now principal consultant to CHEMBIOMED Ltd., the company based on his internationally acclaimed research, Dr. Lemieux has seen his work translated into a line of monoclonal antibody blood typing reagents.

Dr. Ronald Micetich

[illegible] in the field for [illegible] more than 15 years and [illegible] generation of antibiotic drugs [illegible] clinically tested in the United States, Japan and Europe. Following a decade of contract research for Japan's Taiho Pharmaceutical Company, Dr. Micetich and Taiho established Alberta-based SynPhar Laboratories Inc. as a joint venture to research and develop advances in antibiotics, antivirals and anticancer drugs.

Dr. Antoine Noujaim and Dr. Michael Longenecker

Well over a decade of collaborative research in the fight against cancer by two University of Alberta scientists, radiopharmacist Dr. Noujaim and immunologist Dr. Longenecker, has resulted in the [illegible]

Dr. Peter Pang and Dr. Larry Wang

Dr. Bill Scowcroft and Dr. Maurice Maloney

to regulate the expression of genes. In particular, their work involves improving the quality of Canola oil and producing new varieties of Canola to make novel oils and waxes for industrial purposes.

At the University of Alberta's Plant Biotechnology Centre, Dr. Szalay, a Professor of Molecular Genetics leads a team of researchers studying genetic engineering of trees and crop plants for protection from insects and pathogens, the engineering of medicinal plants for production of pharmaceutical compounds, and soil microorganisms for removal of undesired toxic compounds from our soils and lakes to protect the environment. Recently, a research partnership was established between the Max Planck Institute of Koln and the Plant Biotechnology Centre of Alberta. Gene transfer technology applied to plant systems will undoubtedly generate novel technologies for modern pharmaceutical, forestry and agriculture based industries.

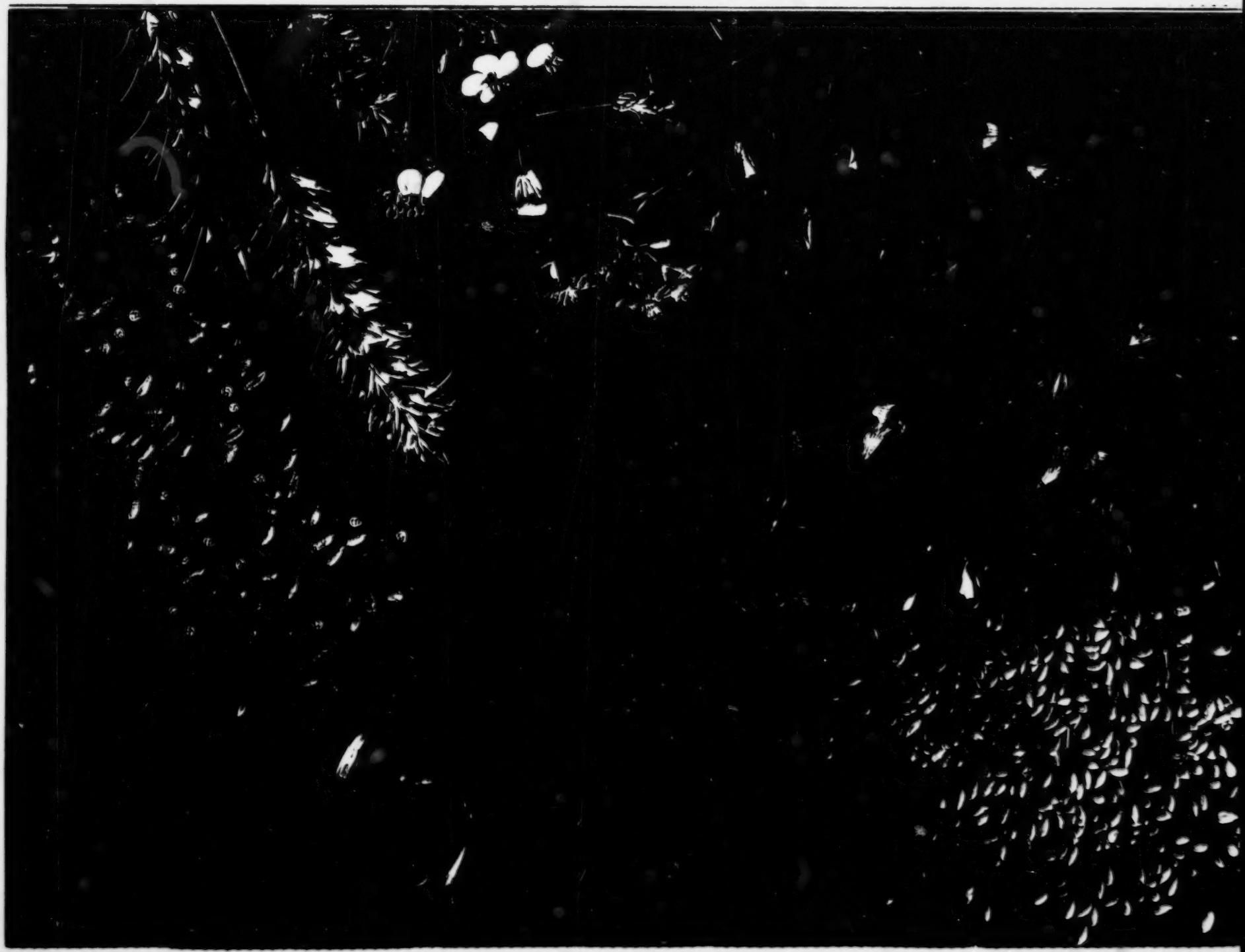
Dr. Thorpe's work in the micropropagation of conifers and research to improve salt tolerance in plants, has attracted world attention to his laboratory at the University of Calgary. An Associate Dean, Research, Faculty of Science, University of Calgary and affiliate scientist of the National Research Council Plant Biotechnology Institute in Saskatoon, he is also an advisor on plant development to nations such as Costa Rica, Malaysia, the Philippines and South Korea.

Dr. [illegible] Tyrrell

At the University of Alberta, Dr. Tyrrell is developing therapies against various viral diseases which have eluded treatment: hepatitis B, Epstein-Barr, Varicella Zoster, Herpes genitalis, and Herpes labialis. Recent work in his laboratory could lead to an effective oral antiviral therapy against hepatitis B in the next five years.

Dr. Tom Wegmann

[illegible] owned company [illegible] Ltd. Dr. Wegmann and his scientific team have developed a range of diagnostic and research products used in laboratories around the world. The group has developed highly accurate cell passage systems which allow viable cell recovery in enumeration and functional studies.



Alberta's Expertise

playing a role in world markets

Since biotechnology research was identified as a priority in Alberta, the province's scientific entrepreneurs have increased and diversified their expertise. Today the Province has developed recognized strengths in applying biotechnology to the pharmaceutical and health care fields, agriculture, and the food processing industry. Alberta's biotechnology firms are exporting their products to the United States, Western Europe, the Pacific Rim, and the Soviet Union.

Human Health Care

The strong focus on biomedical research at both the University of Alberta and the University of Calgary, supported by the Alberta Heritage Foundation for Medical Research, has contributed to Alberta's expertise in applying biotechnology to the improvement of human health care.

The talents of university researchers have already been translated into a number of successful commercial ventures.

Over the past decade **CHEMBIOMED Ltd.** has emerged as one of Canada's largest producers of monoclonal antibodies and of complex sugars. The company is holder of four of the first five FDA-approved monoclonal antibody blood typing reagent licenses in the USA. Its products are playing a role, internationally, in organ transplant procedures.

BIOMIRA Inc. is marketing *in vitro* cancer diagnostic kits, and is collaborating with researchers at the Edmonton Cross Cancer Institute, to fund a $1.3 million research project involving the use of monoclonal antibodies to detect and treat pelvic cancer.

BIOMIRA Inc.

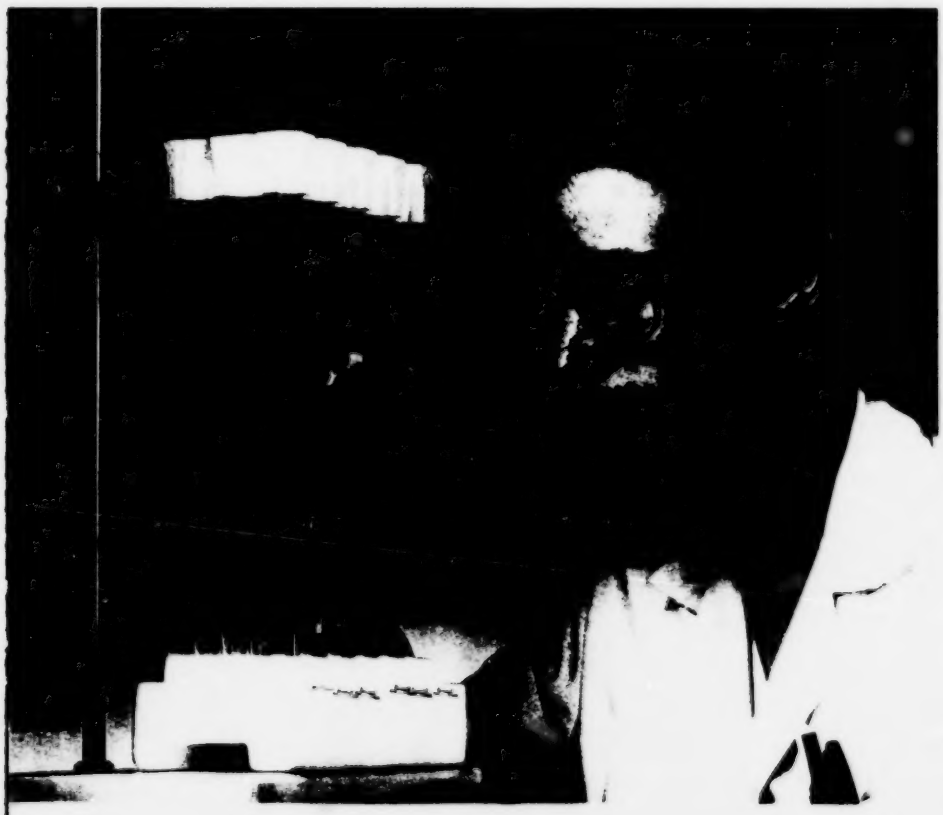
One of the first pharmaceutical research and development companies in western Canada, **SynPhar Laboratories Inc.**, specializes in the design, synthesis and testing of antibiotics, antivirals, antifungals, and anticancer drugs. SynPhar and **Taiho Alberta Ltd.**, its commercial arm, were created in a landmark agreement with a Japanese pharmaceutical firm, Taiho Pharmaceutical Co. Ltd.

Edmonton's **Synthetic Peptides Incorporated** is developing peptide-based pharmaceuticals, diagnostics, and synthetic vaccines, along with the sophisticated computer software and related tools required by international developers of peptide products.

Edmonton's **Raylo Chemicals**' expertise is in nucleosides. The company is a major international supplier of biochemicals. Raylo's work in DNA replication and biotechnological applications earned it the 1987 Canadian Advanced Technology Association award for emerging technologies.

At the University of Calgary, major commercial success have come from the generation of products which are being licensed by companies such as VenTech Healthcare Corporation Inc. (quickly becoming one of Canada's largest health care companies), Dupont Biotechnology Inc., Applied Biosystems Inc., and Connaught Biosciences Inc.

Scale-up of pharmaceuticals – SynPhar Laboratories Inc.



T-cell purification using Cell Passage System(tm) – Sci Can Diagnostics Ltd.

Freezing genetic material in liquid nitrogen.

A considerable amount of work is in the area of diagnostic probes for determining human and infectious diseases. DNA probes from a number of laboratories are being licensed for the detection of diseases and disorders associated with genetic defects.

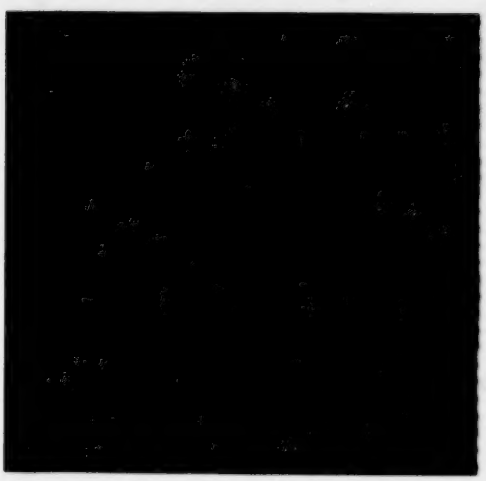
The **Regional DNA Synthesis Laboratory** in Calgary acts as a commercial enterprise. Emanating from the Faculty of Medicine, the operation provides custom DNA synthesis for genetic probes and oligonucleotides and serves universities, industry, and government laboratories across Canada.

Another University of Calgary laboratory which operates commercially is the **Molecular Diagnosis Laboratory**. Under expert direction it offers DNA fingerprinting for parentage and forensic analysis.

Genetic Imaging Inc. is a result of the collaborative research of two University of Calgary scientists. The company is developing computerized instrumentation to speed and simplify the analysis of genetic material.

Efforts in the development of biologicals, such as vaccines, biotherapeutics, peptides, hormones, antibiotics, and molecular diagnostics (monoclonal antibodies and DNA/RNA probes) have resulted in a cooperative venture with a Japanese pharmacological company. **Japan Immunological Research Canada Inc.** has established a research program in biotherapeutics and methods for cancer diagnosis, and the treatment of AIDS.

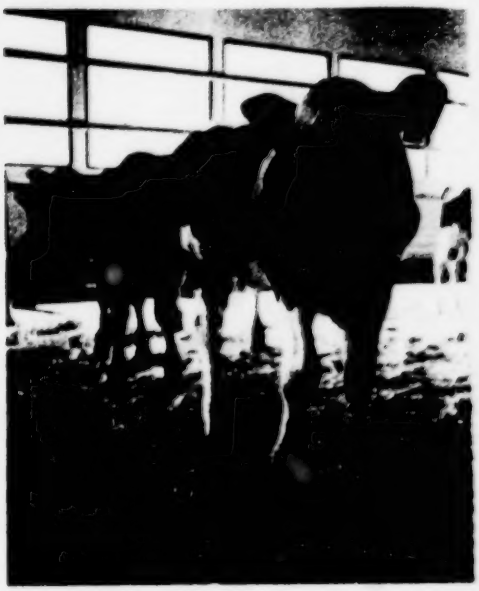
In support of these efforts, bioprocess engineers on the Calgary campus are developing a continuous immobilized cell bioreactor for high-yield production of pharmaceuticals, including antibiotics, and monoclonal antibodies.



T and B cells stained with monoclonal antibodies for further analysis.

(left) Micromanipulation of bovine embryos, as part of the cloning procedure – Alta Genetics Inc.

(below) Cloned calves produced by nuclear transplantation.



Agriculture

The importance of agriculture and food processing to the Alberta economy sparked an early interest in animal and plant biotechnology. A network of government agricultural agencies and veterinary laboratories, including Canada's largest federal agriculture research station at Lethbridge, has traditionally focused on improving agricultural productivity. The agriculture industry has been quick to utilize new technologies, and with the recognition that Alberta has one of the world's most productive and technologically-advanced agricultural sectors, there have been substantial efforts in research and commercialization.

Animal Production

University of Calgary animal biotechnology researchers have made major contributions to Canada's efforts in the application of genetic and biotechnology techniques to animals. Working closely with the private sector, their efforts in creating the world's first cloned and transgenic bovine animals have culminated in two thriving Calgary enterprises, both well recognized in international markets.

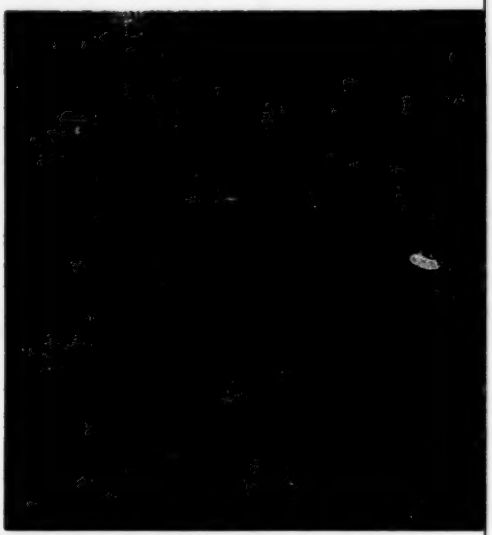
Alta Genetics Inc. (AGI) began operation in May 1986 and is the successor company to **Alberta Livestock Transplants Ltd. (ALT)**. ALT was formed in 1971 as the first commercial embryo transfer firm in the world. In succeeding years the main focus was on the international beef industry and ALT became one of the largest embryo transfer firms in the world, with production of up to 10,000 frozen embryos per year. The company has a long research list, having pioneered a number of developments in animal biotechnology through its well established collaborative research with the University of Calgary. AGI's research program is on the cutting edge of animal biotechnology in cloning and genetic engineering of livestock.

In January 1988, AGI amalgamated with **Western Breeding Service Ltd.** which is now in its 20th year of operation. The merger resulted in the formation of a major genetic centre for worldwide livestock production.

Plant Biotechnology

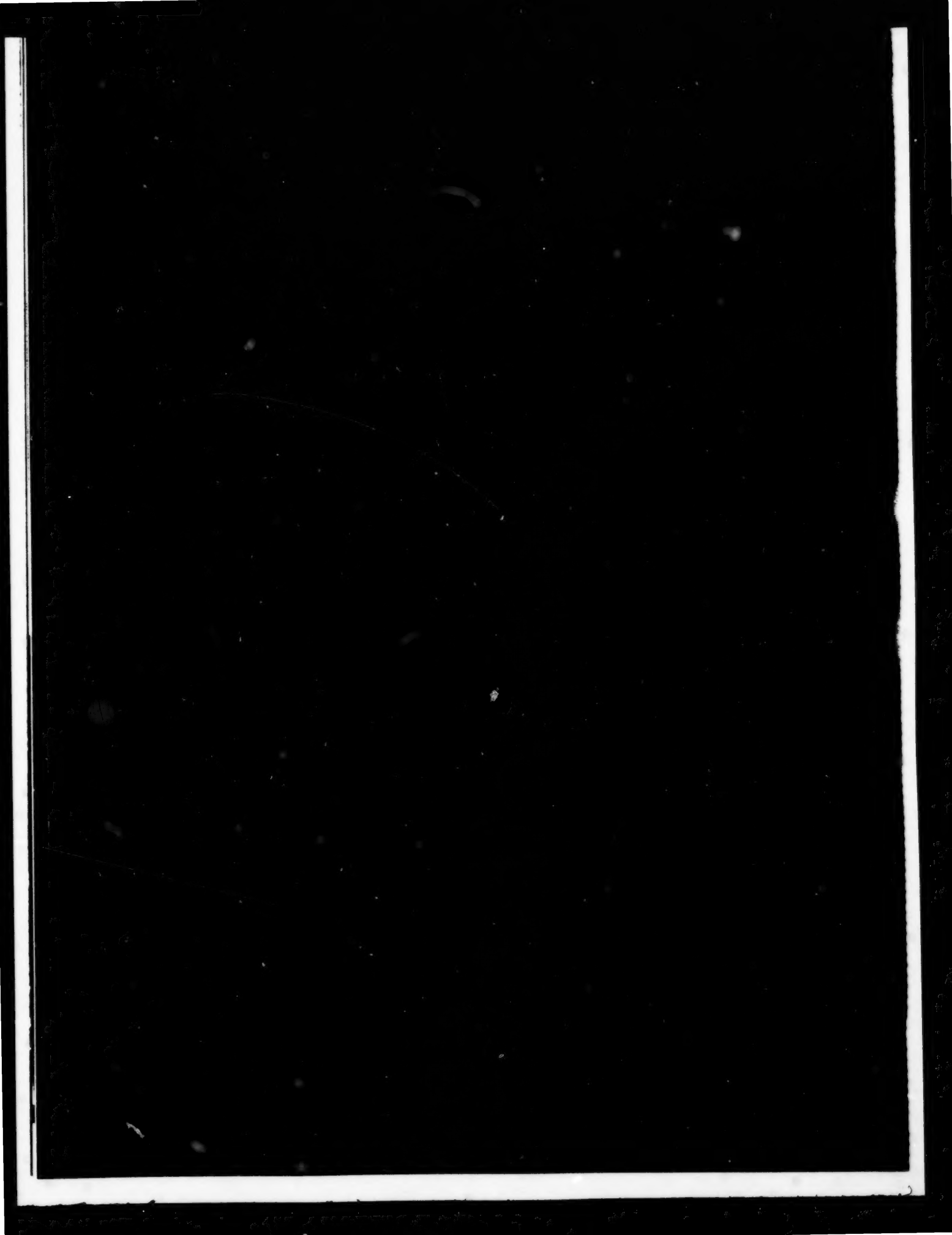
Calgary's **Biotechnica Canada Inc.**, with another two operations (one in the United States and one in Britain) is one of Canada's largest biotechnology organizations. The company is applying expertise in cell and tissue culture, plant breeding, biochemistry, and molecular biology, to plant biotechnology. Products for inhibiting mold growth in hay and improving lactic acid production in silage are sold internationally. The company's first major project, a silage and hay preservative, is enjoying multi-million dollar sales. By 1990 the company expects to market a herbicide-tolerant canola seed. The firm is also working with RJR Nabisco on research designed to modify various crop plants to make them more valuable to the food industry.

The **Alberta Wheat Pool** plant breeding biotechnology program, established in 1981, resulted in three "Ultra bred" varieties of Canola being licensed in 1988. The Alberta Wheat Pool is also collaborating with Monsanto Canada to field test genetically engineered Canola, aimed at helping growers control weeds and practice improved soil management.



(above) Examining Canola DNA for use in gene isolation experiments – University of Calgary.

(left) Genetically-altered Canola plants being tested under greenhouse conditions – Biotechnica Canada Inc.



Pursuing Opportunities

Fostering research is a prime objective in Alberta. The province's scientists continue to achieve in a spectrum of opportunity areas.

Forestry

Alberta's extensive forests represent one of the last major timber resources in North America offering many opportunities for commercial development. In order to safeguard and enhance the resource, Alberta researchers are using the tools of biotechnology to create superior trees: larger than their predecessors, resistant to disease; and able to tolerate the stresses created by climate, insects, and browsing animals.

The **Plant Physiology and Research Group** at the University of Calgary is applying tissue culture technology to forest improvement. The group is considered a world leader in formulating protocols to produce plantlings (i.e., clones) from the tissues of several Canadian conifer species. This technology can ultimately be used in reforestation or tree farming of superior strains of all 10 major Canadian conifers. Also being explored is the role of gibberellins (plant growth hormones) in order to identify the most rapid "growers" for reforestation purposes.

Calgary researchers are participating in a number of joint research projects with major forest industry organizations such as MacMillan Bloedel and Weyerhauser.

Also expected to have a major impact on the forest industry is research being conducted at the **Plant Biotechnology Centre** in the University of Alberta's Faculty of Agriculture and Forestry.

Gemini Biochemical Research Ltd.

Environment

Biotechnology is not only being used to improve industrial processes — as in enhanced oil recovery — but to answer many of the environmental problems associated with industrial activity.

NOVA/Husky Research Corporation, one of Alberta's largest private research organizations, is developing, in its Environmental Biotechnology Program, underground anti-microbial systems designed to control unwanted water production in heavy oilfields.

Calgary's **Gemini Biochemical Research Ltd.** is investigating commercial applications for methane oxidizing bacteria, production of microbial pesticides, and the use of biocatalysts (such as those found naturally in methane oxidizing bacteria) to convert methane to methanol.

University of Calgary researchers are studying ways to use various strains of bacteria to literally "eat up" pollutants such as heavy metals and radioactive materials, improve enhanced oil recovery, reduce pipeline corrosion, consume explosive methane gases in mines and recover metal from mine tailings.

At the **Alberta Environmental Centre**, scientists are developing a biopolymer by fermentation with applications in waste treatment, medicine, and agriculture. They are also working on a biological method of treating pulp mill effluent to remove color, and, in a collaborative effort with Chinese scientists, they are using agricultural and forestry wastes such as straw and sawdust as a medium for producing exotic mushrooms.

This directory presents a selection of companies in the biotechnology industry in Alberta.

Included are research and development companies; manufacturers of human and animal health care products; makers of products for the food and agricultural industries; producers of products for use in medical, biotechnology or other research areas; companies offering testing services and consulting services; providers of raw materials; as well as organizations in other industries, such as oil and gas, which have biotechnology research programs aimed at applying biotechnology to improve their operations.

The Alberta biotechnology industry offers attractive opportunities for investors, entrepreneurs, scientists, researchers, and innovative organizations who want to get involved in leading-edge biotechnology through joint venture arrangements, licensing agreements, investments, or purchase of products or services.

Each profile provides a brief description of the company's products and services, as well as its sales, export, and/or research activities. Please contact any of these firms for more information on products, operations, or expertise.

Prairie Biological Research Ltd.

A

Alta Genetics Inc.

Site 12, Box 12
R.R. 4
Calgary, Alberta
T2M 4L4
(403) 239-8882

Contact: Ted Mitenko, Vice President

Company Founded: 1986

Products and Services: Alta Genetics specializes in the development, production and marketing of elite livestock genetics, using the most advanced reproductive techniques. The company's scientific expertise includes bovine embryo transfer and micromanipulation, sexing and cloning technologies.

The Alta Genetics Production Unit houses a modern embryo transfer facility suited to non-surgical and surgical embryo collection and transplantation.

The Alta Genetics Research Unit has facilities for embryological research in "in vitro" fertilization, embryo sexing, gene injection, and nuclear transplantation.

Sales Activity: Alta Genetics markets its products worldwide and has negotiated contracts in Australia, New Zealand, People's Republic of China, Czechoslovakia, Hungary, U.S.S.R., Holland, France, United Kingdom, Argentina, Chile, Mexico, Brazil, Uruguay and the United States. The company has established Canada's first agricultural joint venture with the U.S.S.R.

Research Activity: The company has a program to develop further advanced technology, which will result in higher yields being produced through nuclear transplantation techniques.

B

BIOMIRA Inc.

Edmonton Research and
Development Park
9411 - 20 Avenue
Edmonton, Alberta
T6N 1E5
(403) 450-3761

Contact: Gordon Politeski, President

Company Founded: 1985

Products and Services: BIOMIRA is involved in the research, development and commercialization of cancer diagnostic and therapeutic products, based on innovative, proprietary, monoclonal antibody, conjugation and synthetic antigen technologies. BIOMIRA was founded by two University of Alberta professors, Dr. B.M. Longenecker (an immunologist) and Dr. A.A. Noujaim (a radiopharmacist), and now employs more than 80 people. BIOMIRA is listed on the Toronto, Alberta and Montreal exchanges under the symbol BRA.

BIOMIRA has four *in vitro* cancer diagnostic kits on the market: TRUQUANT® GI (tm), a test for gastrointestinal cancer, and TRUQUANT® OV (tm), a test for ovarian cancer, TRUQUANT® BR (tm), a test for breast cancer and TRUQUANT® PSA (tm), a test for prostate cancer. The kits are used to monitor the progression of the cancer and to assist the physician in choosing the most suitable therapy for the patient.

Sales Activity: The company's products are sold to the medical, diagnostic and pharmaceutical industries worldwide. Currently, the kits are being sold in North America through BIOMIRA's direct sales force. A distribution agreement was negotiated in April 1988 with Baxter Healthcare for Western Europe, Australia and New Zealand. A distribution agreement has been concluded for Japan with Amersham Medical Registration and will be completed by the end of 1989 with

sales to begin January, 1990. Licensing agreements with English and French companies for antibodies to run on automated systems were concluded in 1989.

Research Activity: *In vitro* tests for the presence of lung, breast and prostate cancers are currently under development. BIOMIRA is also vigorously investigating therapeutic use of monoclonal antibodies (MAbs). The company is exploring the use of MAbs with various drugs, toxins and other antineoplastic agents and the potential of synthetic cancer antigens to immunize cancer patients in remission.

BIOSYS Alberta Ltd.

c/o Alberta Research Council
Biotechnology Pilot Plant
P.O. Box 8330
Postal Station F
Edmonton, Alberta
T6H 5X2
(403) 450-5357

Contact: Steve Speer
Manager, Pilot Production

Company Founded: 1983

Products and Services: BIOSYS is a biological pest control company with headquarters in Palo Alto, California, and is established in Alberta as BIOSYS Alberta Ltd. The company has signed a long-term contract with the Alberta Research Council (ARC) to scale up the technology it developed, for growing nematodes (tiny insect killing organisms), at the ARC's Biotechnology Pilot Plant. BIOSYS has plans to build a production plant in Edmonton, which should be fully operational by 1992. The facility will employ about 95 people and will produce nematodes, which attach soil-borne insects that normally harm plants.

Sales Activity: The nematodes will eventually be sold to corporate distributors, farmers, turf companies, and gardeners as a biopesticide, and are aimed at the North American market.

Biotechnica Canada Inc.

#170, 6815 - 8 Street N.E.
Calgary, Alberta
T2E 7H7
(403) 295-0383

Contact: Murray W. Ruhr, President

Company Founded: 1985

Products and Services: Biotechnica Canada Inc. (BTC) was established as a joint venture between Vencap Equities Alberta Ltd. and Biotechnica International of Massachusetts. Biotechnica Canada Inc. employs advanced biotechnology for the improvement of oil seeds, cereals, and forage crops for the agricultural industry.

Sales Activity: The company develops products for, and markets agricultural products throughout Canada.

Research Activity: Biotechnica has established a joint venture research project with an Australian group, the Commonwealth Scientific and Industrial Research Organization, to develop and commercialize flaxseed as a new edible oil product. BTC and RJR Nabisco Company are collaborating under a research partnership to develop new food products for Nabisco Brands and Del Monte.

C

CHEMBIOMED Ltd.

Edmonton Research and
Development Park
P.O. Box 8050, Station F
Edmonton, Alberta
T6H 4N9
(403) 450-6800

Contact: Dr. Frank M. Unger
Senior Vice President
Research and Development

Company Founded: 1977

Products and Services: CHEMBIOMED is an industry leader in quantity synthesis of biologically active carbohydrates for human health care, and is currently owned by the Government of Alberta. The firm's major product lines include the following:

- SYNTYPEs (tm), monoclonal antibody reagents used to determine blood type. CHEMBIOMED was the first company in the world to market, and the first to obtain a Japanese Ministry of Health license for, monoclonal antibody-based blood typing reagents.
- SYNSORBs (tm), a total of 13 products, used for removing antibodies from blood fractions to reduce adverse side effects from therapeutic applications of blood products.
- SYNTAGENs (tm), synthetic carbohydrate antigens, used as immunogens in the production of monoclonal antibodies, and to identify corresponding circulating human antibodies.
- BIOSYNSORBs (tm), chemically synthesized antigens bonded to silica beads, used to cleanse blood of antibodies that attack blood group determinants on grafted tissues. This treatment allows organ transplants for incompatible blood types.

Sales/Export Activity: The company markets its products to health care and research facilities worldwide. 90% of sales are to export markets. By fiscal 1991/92, sales are expected to exceed $30 million.

Research Activity: The company's scientists are currently working on injectable forms of synthetic carbohydrate A and B antigens, trademarked SYNJECT, for use in heart, liver, lung and pancreas transplants. CHEMBIO-MED is also involved in a research program aimed at a drug to stop the spread of infection by the AIDS virus within the body.

G

Gemini Biochemical Research Ltd.

Bay #5, 245 - 2nd Avenue East
Cochrane, Alberta
T0L 0W0
(403) 243-4171

Contact: Ian Forrester, President

Company Founded: 1981

Products and Services: Gemini carries out research in biotechnology, applied chemistry and environmental sciences, aimed at improving the use of Alberta's natural resources.

The company's major projects have included the liquefaction of biomass, production of polymers for enhanced oil recovery, separation of alcohols from fermentation broths, design of affordable bioreactors, production of microbial pesticides, development of less expensive fermentation systems, microbial de-emulsification of oily water, and commercial applications for methane oxidizing bacteria such as to reduce the concentration of methane gas in coal mines or in holds of ships transporting coal.

Sales Activity: Gemini's research and development services are sold to the agriculture, forestry, oil and gas, and coal mining industries. The affordable bioreactors are targeted at third world governments.

Research Activity: Future research and development activities include work in microbial polysaccharides, fermentation technology, soil microbiology, use of natural gas as feedstock for fermentation, petrochemical transformations and alternative energy (bioenergy).

Gibmar Laboratories Ltd.

21339 Township Road 524
Ardrosson, Alberta
T0B 0E0
(403) 922-2170

Contact: Jim G. Watson, President

Company Founded: 1981

Products and Services: Gibmar Laboratories Ltd. produces a full line of prepared culture media, bloods, serums, as well as antibodies. By-products are collected from both donor animals as well as from the company's abattoir.

Sales Activity: Products are sold to hospitals, clinics, microbiological, and medical labs — private as well as public. Markets are national.

N

Norac Technologies Inc.

4222 - 97 Street
Greystone Pavilion
Edmonton, Alberta
T6E 5Z9
(403) 461-7163

Contact: Dr. D.A. Evans
Vice President
Product Development

Company Founded: 1985

Products and Services: Norac Technologies owns and operates one of the most diverse and innovative pilot extraction centres in the world; it is based on a process called Supercritical Gas Extraction. Substances such as vegetable oil, flavors, fragrances, colorants and pharmaceutical products, used for everything from food to cosmetics and medicine, are extracted from various agricultural raw materials. A full commercial plant is currently under construction and will come online in late 1990.

Traditional extraction methods use organic solvents, like methanol. Norac's Supercritical Gas Extraction method uses biologically harmless substances, such as CO_2 gas. This is a safer method, resulting in higher levels of purity and quality.

The company provides research, product development and design services for supercritical extraction applications, but, as a product oriented company, its main objective is the supply of high quality solvent-free ingredients to the world's food, beverage, cosmetic and pharmaceutical industries.

Sales Activity: The company markets its services to the food, spice, aroma, health food, pharmaceutical, biotechnology and cosmetic industries.

Research Activity: Biotechnology research presently being undertaken by Norac includes the following:

- A joint venture project with an Edmonton biotechnology firm to extract both polar and non-polar glycolipids from animal byproducts. This research should result in separation technology that is the first of its kind in the world.
- A combined effort with the Alberta Research Council's Biotechnology Pilot Plant to establish supercritical technology for the continuous recovery of high-value products from fermentation broths.

Nova Husky Research Corporation

2928 - 16 Street N.E.
Calgary, Alberta
T2E 7K7
(403) 250-4700

Contact: Dr. Grant Ferris

Company Founded: 1982

Products and Services: Nova Husky Research Corporation is a wholly-owned subsidiary of Nova Corporation of Alberta and Husky Oil Ltd. serving the research needs of its corporate parents. Biotechnology research includes petroleum microbiology, biologically induced corrosion, materials degradation and microbially enhanced oil recovery.

P

Prairie Biological Research Ltd.

Block C
4290 - 91 A Street
Edmonton, Alberta
T6E 5V2
(403) 450-3957

Contact: Dr. Ram D. Mehta, President

Company Founded: 1984

Products and Services: Prairie Biological Research Ltd. (PBR) provides genetic toxicology and biological testing services. The company's tests screen for toxic substances, especially carcinogens, which pose a potential hazard to human health. PBR identifies carcinogens through gene mutation and chromosomal damage tests, providing rapid and cost-effective information.

Substances tested include pharmaceuticals, pesticides, cosmetics, food additives, petroleum products, industrial chemicals, medical devices and environmental samples. The firm will also examine soil, air and water samples for microbes and chemical pollutants, and test pharmaceutical and medical devices for sterility. PBR will also test employees, such as nurses or mine workers, for exposure to toxins that are handled in the workplace.

The company offers biotechnology safety consulting services, advising biotechnology firms on precautions to take to protect workers and the environment from potential pathogens and genetically-engineered organisms produced by using DNA processes.

Sales Activity: Services are provided to firms in the chemical, microbiological, environmental, and pharmaceutical industries as well as to hospitals, governments, property management, mining companies, and organizations which deal with potentially harmful substances.

Research Activity: PBR is actively involved in state-of-the-art research on new test and protocol development, test system validation and chemical service programs. The company is also involved in the development of plant tissue culture cloning techniques.

R

Raylo Chemicals

Division of Terochem Laboratories
8045 Argyll Road
Edmonton, Alberta
T6C 4A9
(403) 468-6060

Contact: Mathew Colomb
Commercial Manager

Company Founded: 1963

Products and Services: Raylo Chemicals researches, develops, and manufactures high technology specialty chemicals. The company is Canada's largest producer of high-tech chemicals and the number one manufacturer of modified nucleosides (biochemicals), worldwide.

Sales Activity: The company markets its products to the biotechnology industry, to some of the world's largest pharmaceutical companies, to the photographic industry and to many other industries that require specialized chemicals.

Raylo has many contracts in the field of pharmaceutical chemistry, and has been a prime supplier to the U.S. National Institutes of Health for a number of experimental anti-AIDS drugs in commercial quantities. Its specialization in nucleoside chemistry has also been recognized by many multinational pharmaceutical firms who have placed orders for chemicals having potential anti-cancer and antiviral activity.

Export Activity: Raylo has a very strong presence in international markets, 95% of its sales are to the U.S., the U.K., and Europe.

S

SynPhar Laboratories Inc.

4290 - 91 A Street
Edmonton, Alberta
T6E 5V2
(403) 462-4044

Contact: Dr. Ronald Micetich
President

Company Founded: 1987

Products and Services: SynPhar Laboratories Inc. is a joint venture pharmaceutical research and development company between Taiho Pharmaceutical Co. Ltd. of Japan and Dr. Micetich. SynPhar's main areas of research are in designing, synthesizing and testing potential commercial drugs for infectious diseases. Areas of specific interest are antibiotics, antiviral, anticancer, and antifungal agents. SynPhar is also interested in specific aspects of drug delivery. The long range plan includes the possibility of establishing a manufacturing and marketing operation in Canada that will serve North America in particular.

S.P.I. Synthetic Peptides Inc.

Room 355
Medical Sciences Building
University of Alberta
Edmonton, Alberta
T6G 2H7
(403) 492-3155

Contact: Dr. Bob Hodges, President

Company Founded: 1986

Products and Services: S.P.I. Synthetic Peptides Inc. (SPI) was founded as a research and development company to commercialize products in the area of peptide pharmaceuticals, peptide diagnostics and synthetic vaccines utilizing the expertise of Dr. Robert S. Hodges and Dr. J.M. Robert Parker in the areas of synthesis, purification and manufacturing scale-up. S.P.I. shareholders include the University of Alberta and Capital Markets West Inc., an Alberta-based venture capital firm. The company operates from a laboratory on the University of Alberta campus and has entered into a long-term technology transfer agreement with the University. S.P.I. performs custom design and synthesis of peptides for a wide range of commercial customers. S.P.I. has developed a family of computer software programs which can be used to assist in the design of biologically active peptides and proteins.

Research Activity: S.P.I.'s major research thrust is the investigation of alternatives to blood transfusions. Several peptides which will significantly reduce bleeding during and after surgery are currently being evaluated.

Sales Activity: Software is currently being marketed to biotechnology and pharmaceutical researchers and universities by distributors in North America and Europe.

V

VenTech Healthcare Corporation Inc.

Suite 1500, Canada Life Tower
736 - 6 Avenue S.W.
Calgary, Alberta
T2P 3T7
(403) 265-3035

Contact: Ronald R. Cripps, C.A.
Chief Financial Officer

Company Founded: 1986

Products and Services: VenTech Healthcare offers an integrated product line of traditional and high technology medical tools. The company specializes in the distribution of medical and home health care products for the Canadian and U.S. markets. Combined annualized revenues are currently in excess of $400 million.

Research Activity: The company has a designated person responsible for coordinating technology transfer with Canadian universities and industry. This encourages researchers and industry to dialogue with each other and the results have been encouraging.

Vista Laboratories Ltd.

8432 - 45 Street
Edmonton, Alberta
T6B 2N6
(403) 468-0020

Contact: Colin Wylie, President

Company Founded: 1976

Products and Services: Vista Laboratories Ltd. develops and manufactures medical laboratory equipment. The firm's primary product is the Isoplater 80 (tm), an automated petri dish spreading machine, for use in microbiological laboratories.

Sales Activity: Vista markets its products to hospitals, universities, private medical laboratories and industry.

Export Activity: The company is currently in negotiations to have Vista's products distributed worldwide.

Petri plate processer for isolating pure cultures - Vista Laboratories Ltd

W

Westra and Associates Inc.

7807 - 121 Avenue
Edmonton, Alberta
T5B 4T3
(403) 471-2553

Contact: Dr. Robert Westra
President

Company Founded: 1983

Products and Services: Westra and Associates provides computer training, biotechnology research and development, and animal health and nutrition consulting services. The company markets Barlein (tm), a livestock protein supplement and Rats (tm), a cattle nutrition balancing formulation software.

The company performs Farm Feasibility studies, including research of scientific literature, based on economic principles, and has experience in putting together agriculture feasibility projects in Canada, Egypt, Central America and the United States.

Westra is involved in active research in feeding wood to ruminants, novel and new proteins to animals.

Sales Activity: Westra markets its products to the agricultural industry.